CHAPTER 1. INTRODUCTION

In this chapter, we provide the context for this paper by briefly discussing international and U.S. efforts to reduce greenhouse gas emissions. After reviewing the key objectives of this paper (including the examination of the issues and methodologies involved in monitoring, evaluating, reporting, and verifying climate change mitigation projects), we focus on one of the key issues to be addressed in the development of new guidelines and protocols, the monitoring domain. We conclude by explaining how the guidelines and protocols will be invaluable for an international carbon trading system.

1.1. Background

Because of concerns with the growing threat of global climate change from increasing emissions of greenhouse gases, more than 166 countries (as of May 13, 1997) have become Parties to the U.N. Framework Convention on Climate Change (FCCC) (UNEP/WMO 1992). The FCCC was entered into force on March 21, 1994, and the Parties to the FCCC are now in the process of negotiating a new legal instrument (either as an amendment or a protocol) to be adopted in December 1997. Under the FCCC, Annex 1 countries (i.e., the developed countries) are required to reduce their emissions in the year 2000 to 1990 levels. Non-Annex 1 countries (i.e., developing countries and countries in transition) do not have this requirement.

In July 1996, the United States outlined a broad framework for negotiation of next steps under the FCCC, and in December 1996, the U.S. further elaborated its ideas by describing the key elements that should be discussed for inclusion in a protocol to guide greenhouse gas (GHG) emission reduction efforts in the post-2000 period. In January 1997, the U.S. presented a draft protocol to the FCCC's Secretariat for consideration in international negotiations in 1997. In this case, the "protocol" does not refer to a set of project-specific guidelines or methodologies. Instead, the protocol simply establishes a framework for addressing the following key topics at the national level:[1] emissions targets; reporting and compliance; advanced developing country efforts; emissions trading and joint implementation; and long-term effects under the FCCC.

[1] An exception are joint implementation projects, which are international in scope and refer to cooperative development projects that seek to reduce or sequester GHG emissions and involve parties in two or more cooperating countries. Some of the issues confronting joint implementation projects are discussed in this paper.

The second topic (reporting and compliance) is the focus of this paper. The U.S. proposal establishes procedures to ensure the reporting and measurement of anthropogenic emissions by sources, and removals by sinks, of greenhouse gases at the national level.[1] For example, countries would have to set national systems for measuring emissions accurately, achieving compliance with emissions targets, and ensuring enforcement for meeting emissions targets. Also, annual reports on measurement, compliance and enforcement efforts at the national level would be required and made available to the public. The preparation of such reports involves many complex analytical and institutional issues as they relate to climate change mitigation projects, as discussed in this paper.

1.2. Objectives of the Paper

The primary purpose of this paper is to review the issues and methodologies involved in monitoring, evaluating, reporting, and verifying (MERV) climate change mitigation projects in order to provide guidance for the development of new protocols and guidelines for these activities. In the context of this study, protocols refer to specific rules that must be followed (e.g., methods for measuring soil carbon), while guidelines are more general (e.g., topics to address). We also review the way existing GHG and non-GHG protocols and guidelines address MERV issues. This report covers all climate change mitigation projects, including Joint Implementation (JI) and Activities Implemented Jointly (AIJ) projects (see below).

The focus of this paper is: (1) at the project level, not at the program level (e.g., utility energy-efficiency programs, or national joint implementation programs); (2) primarily at the local level with well-defined system boundaries, not at the national level; and (3) on the issues and methodologies related to the MERV of climate change mitigation projects, not the actual development of guidelines or protocols (the subject of the next phase of our study). The target audience of this report is primarily government policymakers, but we hope that this report will also be useful for project developers and investors, nongovernmental organizations, and the research community.

Climate change mitigation projects typically proceed through three phases: (1) project development (e.g., bringing together project investors and hosts, preparing feasibility studies, estimating the GHG reduction, and negotiating contracts); (2) project implementation (e.g., training project staff, implementing the project, managing the project finances, and preparing reports); and (3) project

[1] GHG sources include emissions from fossil fuel combustion, industry, deforested biomass, soil carbon loss in deforested areas, methane from agricultural activities, etc. GHG sinks include storage in the atmosphere, ocean uptake, and uptake by forest regrowth and sequestration from carbon accumulation (IPCC 1995; Andrasko et al. 1996).

assessment (e.g., monitoring and evaluating the project, calculating the GHG reductions, and verifying the GHG reduction) (Watt et al. 1995). MERV activities can occur in all project phases, for example: (1) the U.S. Initiative on Joint Implementation has an Evaluation Panel that evaluates project submissions during the project development stage (Section 2.1.1); (2) projects could be designed to reduce subsequent MERV difficulties, for example, by addressing leakage, defining baselines, and calculating GHG benefits; and (3) inclusion of easily measurable performance indicators during project development which are correlated to project objectives and which are used in project assessment (personal communication from Samuel Fankhauser, World Bank, Aug. 27, 1997).

The focus of this paper is on project assessment (after a project has started implementation) and the following MERV activities:

1. Monitoring: refers to the measurement of GHG reductions[1] and other associated socioeconomic and environmental impacts and activities that actually occur as a result of a project. Monitoring does *not* involve the calculation of GHG reductions nor does it involve comparisons with previous baseline measurements. For example, monitoring would involve the measurement of kilowatts produced by a wind generator, or the number of hectares preserved by a forestry project. The objectives of monitoring are to inform interested parties about the performance of a project, to adjust project development, to identify measures that can improve project quality, to make the project more cost-effective, to improve planning and measuring processes, and to be part of a learning process for all participants (De Jong et al. 1997).

2. Evaluation: refers to both impact and process evaluations of a particular project, typically entailing a more indepth and rigorous analysis of a project compared to monitoring emissions. Project evaluation usually involves comparisons requiring information from outside the project in time, area, or population (De Jong et al. 1997). The calculation of GHG reductions is conducted at this stage. Project evaluation would include GHG impacts, non-GHG impacts (i.e., environmental, economic, and social impacts), determination of the proper baseline, estimation of leakage and project spillover, etc. Evaluation organizes and analyzes the information collected by the monitoring procedures, compares this information with

[1] GHG reductions refer to GHG emission reductions or carbon sequestration in this paper. Carbon sequestration refers to the process where carbon is absorbed or taken out of the atmosphere and stored in a terrestrial or oceanic reservoir. This differs from the preservation of existing carbon stocks in a reservoir.

information collected in other ways, and presents the resulting analysis of the overall performance of a project. Project evaluations will be used to determine the official level of GHG emissions reductions and carbon sequestration that should be assigned to the project. The focus of evaluation is on projects that have been implemented for a period of time, not on proposals (i.e., project development).

3. Reporting refers to *measured* GHG and non-GHG impacts of a project (in some cases, organizations may report on their *estimated* impacts, prior to project implementation, but this is not the focus of this paper). Reporting occurs throughout the MERV process (e.g., periodic reporting of monitored results and a final report once the project has ended).

4. Verification refers to establishing whether the measured GHG reductions actually occurred, similar to an accounting audit performed by an objective, certified party.

These activities have different objectives and timing, but they potentially have much overlap and interactions among each other as well as among the institutions that might perform these activities (Section 3.10.1).

MERV tasks are expected to include many of the following types of activities:

- installation and operation of equipment, measures and systems
- measurement, data collection, and analysis
- institutional development
- estimation of baseline conditions
- calculation of the amount of energy saved and supplied, GHG emissions and GHG emission reductions, amount of carbon sequestered, and non-GHG impacts (see below)

In this paper, we consider three types of projects: energy efficiency, renewable energy (including bioenergy projects), and forestry. We believe that other kinds of energy projects (e.g., cogeneration and fuel switching) will use methods and approaches similar to those described here. For each of these types of projects, we also discuss appropriate MERV methods (Chapters 4 and 5).

1.2.1. Monitoring domain

One of the key issues in the development of guidelines and protocols is the domain of monitoring that might be envisioned for a particular project. The domain that needs to be monitored (i.e., the monitoring domain, see Andrasko 1997 and MacDicken 1997) is typically viewed as larger than the geographic and temporal boundaries of the project. Consideration of the domain accounts for the following issues: (1) the temporal and geographic extent of a project's direct impacts; (2) upstream and downstream coverage of indirect energy impacts and pre- and post-harvest coverage of indirect forestry impacts; (3) national and international leakage; and (4) off-site (i.e., outside of the project area) baseline changes. If one of the objectives of the guidelines is to provide the capability to compare GHG reductions across projects, then the guidelines need to be consistent in requesting information at the same monitoring domain.

The first monitoring domain issue concerns the appropriate geographic boundary for evaluating and reporting impacts. A climate change mitigation project might have local (project-specific) impacts that are directly related to the project in question, or the project might have more widespread (e.g., regional) impacts. Thus, one must decide the appropriate geographic boundary for evaluating and reporting impacts.

The second monitoring domain issue is related to time and location. For example, energy projects may impact energy supply and demand at the point of production, transmission, or end use. The MERV of such impacts will become more complex and difficult as one attempts to monitor how emission reductions are linked between energy end users and energy producers (e.g., tracking the emissions impact of 1,000 kWh saved by a household in a utility's generation system). Similarly, the MERV of emissions of forestry projects can be conducted at the point of extraction (e.g., when trees are logged) or point of use (e.g., when trees are made into furniture), and when forests are later transformed to other uses (e.g., agriculture, grassland, or range). Thus, one needs to decide whether MERV should focus solely on the emissions from the logging of trees at the project site, monitor the emissions over time from the new land use type, or account for the wood products produced and traded outside project boundaries.

The third and fourth monitoring domain issues occur when questions of "leakage" and off-site baseline changes (i.e., changes occurring outside of the project area) need to be addressed. For example, leakage occurs if a natural forest area, previously used to meet local needs for timber and firewood, is closed due to a preservation project and, as a result, fuelwood and timber are harvested elsewhere (MacDicken 1996; Watt et al. 1995). In addition, some projects may involve international leakages: e.g., in 1989, when all commercial logging in Thailand was banned, the logging shifted to neighboring countries such as Burma, Cambodia and Laos as well as to Brazil. And in energy-efficiency projects, leakage occurs, for example, when innovative building design practices are used by builders outside of the project areas

where these practices were first introduced. Leakage needs to be accounted for if off-site GHG emissions are to be accounted for, rather than those at a particular site. Accordingly, the development of baselines (see below) and the level of MERV in general will be affected by the choice of the monitoring domain.

These problems point out the difficulty of establishing a credible baseline. One could broaden the monitoring domain to include, for example, leakage and off-site baseline changes. Widening the system boundary, however, will most likely entail greater MERV transaction costs. Transaction costs are the costs incurred by the people responsible for monitoring, reporting, evaluating, and verifying climate change mitigation projects. These costs include not only out-of-pocket expenditures, but also opportunity costs (e.g., the lost time (delay) and resources (e.g., money and managerial attention) that could have been devoted to the next best opportunity for that participant (Dudek and Weiner 1996). We revisit these issues later in this paper (Section 3.3.1), but warn the reader that these questions may have to be resolved through an international consensus, rather than addressed through the guidelines or protocols.

1.2.2. Carbon credits and trading

The MERV guidelines will be important management tools for all parties involved in carbon mitigation. They will help project participants determine how effective their contributions have been in curbing GHG emissions, and they will help planners and policy makers in determining the potential impacts for different types of projects, and for improvements in project design and implementation. And they will also be needed for ensuring consistency and transparency across project types and sectors.

In the longer term, MERV-type guidelines will be a necessary element of any international carbon trading system. It is by no means certain that such a system will emerge.[1] In the U.S. draft protocol to the Framework Convention on Climate Change (Jan. 17, 1997), however, the U.S. proposed international emissions trading (Article 6) in which countries could transfer or receive any of its tons of carbon equivalent emissions allowed for a budget period, for the purpose of meeting its obligations. In addition, tons of carbon equivalent emissions reduced by Joint Implementation projects could be transferred to other countries as part of an international emissions trading system (Article 7). The World

[1] Presently, there are no emission credits associated with joint implementation (JI) projects in the pilot phase for joint implementation (or "activities implemented jointly" (AIJ)) under the FCCC (Conference of Parties, Decision 5/CP.1 (Dec. 1995)). Once the AIJ pilot ends, a GHG credit trading regime may emerge. Nevertheless, at the core of the concept of AIJ projects is the need to measure and verify GHG emission reductions, so that the international community can gain experience with and determine the feasibility of measuring GHG emission reductions from AIJ.

Bank's Global Carbon Initiative is also researching various mechanisms and instruments to facilitate a carbon offsets market, one of which is the feasibility of a Carbon Investment Fund (World Bank 1997a).

Under one version of an international emissions trading system, countries would agree to an allocation of maximum emissions for each GHG (see World Bank 1994a). Emissions over the limit would be allowed only if a country purchased additional emission allowances from other countries, or if the country initiated activities that would offset the increase by a decrease in emissions from other activities. A country could also generate saleable allowances by implementing projects that result in a net reduction in emissions. The valuation of such projects will require MERV-type guidelines that are acceptable to all parties. These guidelines will yield verifiable findings, conducted on an ex post facto basis (i.e., actual as opposed to predicted project performance).

It is likely that an international carbon trading regime will require project monitoring of all pools that are likely to decrease or increase over time. For carbon mitigation projects, a key factor will be the relative cost of MERV activities compared to the economic value of fixed or avoided carbon. For example, if carbon credits are worth $10 per ton, it does not make economic sense to spend $20 per ton on MERV. We do not discuss emissions trading issues and guidelines in this report, but simply note the context in which the cost of MERV activities needs to be discussed.

1.3. Organization of the Paper

The rest of this paper is organized into five chapters. In Chapter 2, we review existing protocols and guidelines, some of which are related to greenhouse gases. In Chapter 3, we examine the issues that are generic to the projects under discussion. In the next two chapters (Chapter 4 and 5), we discuss methodological issues in detail (e.g., use of engineering models and explanations of how carbon content in wood and other material is measured) in the energy and forestry sectors, respectively. Readers can skip these chapters and proceed to Chapter 6 where we summarize our review of existing protocols and guidelines as they relate to the issues described in the previous chapters, and where we present our key conclusions.